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Suppliers' Information Note

For The BT Network

IP Connect UK
Service Description

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1. Introduction

This Suppliers' Information Note (SIN) describes BT's IP Connect UK service, which utilises MPLS technology to provide an IP Virtual Private Network capability. The service offers access options using Ethernet, FTTP or xDSL with various rates depending on the access mechanism. This document provides information about the service for use by Customer Premises Equipment (CPE) manufacturers and developers.

2. Service Availability

The BT IP Connect UK service will cover mainland Britain and Northern Ireland (the UK Licenced area), subject to available network capacity.

Ethernet access availability is restricted to be within a given distance from the Network Point of Presence and also depends upon the required resilience. Further detail is specified in the IP Connect UK Product Description.

Geographic availability of xDSL and FTTP access will be made available using BT's broadband checker tools. xDSL access to IP Connect UK will only be provided over BT-provided direct exchange lines. There are also technical limitations depending on factors such as the length of the local loop that may restrict delivery to some users.

For further information please refer to https://www.bt.com/about/sinet

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3. BT IP Connect UK Service Description

3.1. General Service Characteristics

The BT IP Connect UK Service provides both a physical access and a logical connection to a defined IP VPN hosted on BT's Multi–Protocol Label Switching (MPLS) platform. Logical access to single and/or multiple VPNs is supported per physical access . The service is designed to provide any-to-any IP connectivity within a customer defined VPN and supports a combination of IP version 4 and version 6 traffic. The IP Connect UK service offers a range of available access rates.

The access speeds currently supported are listed in Table 1. Note that for Ethernet accesses the Port/Contracted Data Rate (CDR) may be below the access rate; in this case traffic should be shaped on egress at the CPE, and will be policed on ingress to the network.

IP Connect UK Access Rates		IP Connect UK interfaces
100 Mbit/s		100BaseT electrical
1000 Mbit/s		1000Base-SX optical
10GMbit/s EAD		10000Base-LR
10GMbit/s OSA		10000Base-LR
#ADSL1		
Downstream < 8 Mbit/s	Upstream (uncapped or 448kbit/s fixed)	ADSL
ADSL2+		
Downstream (< 24 Mbit/s)	Upstream (uncapped or 448kbit/s fixed)	ADSL
Downstream (fixed rates at 512kbit/s:1Mbit/s or 2Mbit/s)	Upstream (256kbit/s fixed)	ADSL
Super-Fast FTTC/SOGEA		
Downstream 40/80/100Mbit/s Upstream 2/10/20Mbit/s		VDSL G.993.2
Super-Fast FTTP		
Downstream 40/80/100Mbit/s Upstream 2/10/20Mbit/s		10/100/1000BaseT

Table 1. IP Connect UK access rates

3.2. Access

3.2.1. Fibre Ethernet access

For Ethernet accesses the service supports the encapsulation of IP v4 and v6 data packets using IEEE 802.3 [24] Ethernet framing, with 802.1q [25] VLAN trunking protocol for accesses with multiple VPNs.

Where a single VPN connection is provided on an Ethernet access, data will be sent without the VLAN Id field being set in the Ethernet header, i.e. the link will not be configured as an IEEE 802.1q [25] VLAN trunk.

Multiple VPN connections are supported on an Ethernet access by configuring the access as an IEEE 802.1q VLAN trunk with each VPN using an individual VLAN associated with a VLAN ID.

The VLAN ID associated with each VPN connection will be allocated by BT at the time of subscription. VLAN IDs cannot be specified by the customer.

The IP Connect UK service supports Ethernet access with the following interfaces (see SIN360 [27]):

- Fast Ethernet: IEEE 802.3 at 100Mbit/s.
- Gigabit Ethernet: IEEE 802.3 at 1000Mbit/s.
- 10 Gigabit Ethernet: IEEE 802.3 at 1Gbit/s

The access data rate of each Ethernet access will be 100, or 1000Mbit/s, or 1Gbit/s, as per the IEEE 802.3 [24] standard. However, the customer will subscribe to a Port/Committed Data Rate (CDR) for each access that defines the maximum rate at which the customer may send or receive data packets to/from the network. The customer will not be able to burst above the CDR defined for each access.

The service employs numbered IP interfaces between the BT domain and the CPE router equipment. These addresses will be provided by the customer, and require a point-to-point IP subnet with a mask of /30 for v4 and /127 for v6. The higher (even) IP address will be used for the CPE equipment and the lower (odd) for the network.

The IP Maximum Transmission Unit (MTU) value supported by the service is 1500 bytes, any IP packet forwarded to the service larger than 1500 bytes will be discarded.

The customer equipment connected to the service should appear to BT's network as a layer 3 IP router and should present a single 802.3 MAC address. Traffic to all other devices within the customer site should be routed via this device.

No spanning tree mechanism is used on the access link. Customers should not configure their equipment to send spanning tree packets (or other 802.x control packets) on the access circuit.

DiffServ Code Point (DSCP) Class of Service is supported on 100Mbit/s and 1000Mbit/s (1Gbit/s) Ethernet Access. Previously 100Mbit/s Ethernet Access did not support Class of Service for IP Precedence based IP VPNs (ie all traffic will be marked as Class 3 on ingress to the network), although IP Precedence based CoS is supported on Gigabit Ethernet accesses.

For further information on Ethernet Access, please refer to:

SIN 476 - BT Downstream 21CN Ethernet Services, Service Description

SIN 492 - Ethernet Access Direct (EAD) and Ethernet Access Direct Local Access, Service & Interface Description

3.2.2. ADSL1, ADSL2/2 +

ADSL can be provided using ADSL1 or ADSL 2+ technology with upstream speeds of up to 1Mbit/s and up to 24Mbit/s downstream.

ADSL1, ADSL2/2+ access variants are mostly rate adaptive and delivered at optimal speed by a line technology termed Dynamic Line Management (DLM).

DLM analyses network performance information to then determine the overall performance of each individual line through a balance of the maximum achievable line rate against the stability of the line.

If a line is unstable or performing poorly then it is re-configured automatically to try and address this without any manual intervention.

Customer sites connect via a BT Public Switched Telephone Network (PSTN) line to a local ADSL Copper Multi Service Access Node (CMSAN). A single ATM VC (VPI/VCI 0/38) is provided across the physical access between the CMSAN and the customer premises. Point to Point Protocol (PPP) is operating above the ATM layer to provide an end to end layer 2 connection between the customer CE router and the serving MPLS PE router.

For most ADSL options static and dynamic routing is supported. The underlying PPP session established between the customer CE router and serving MPLS PE router is authenticated using a user/domain name and CHAP password. The user/domain name is allocated by BT and consists of the end user access ID (unique to the customer circuit) and the domain name unique to IP VPN. The format is BBEU12345678@adslconnect.bt.com. The password is also BT defined (end user access ID in the format BBEU12345678).

3.2.3. Fibre to the Cabinet (FTTC)

FTTC offers an EU Access option based on VDSL 2 technology, rather than ADSL 1 and ADSL 2/2+ on WBC. This type of EU Access provides a higher line rate of up to 80Mbps downstream and up to 20 Mbps upstream.

The main difference between FTTC and ADSL1/2/2+ Service is that the DSLAM (Digital Subscriber Line Access Module) for the ADSL1/2/2+ Service is situated in an exchange building whereas for FTTC the DSLAM is situated in a street cabinet ("Street DSLAM").
The Street DSLAM is served with a fibre back to the exchange to carry the Broadband signals.

The 'Street DSLAM' is connected to the Street Cabinet using tie pair cables. VDSL 2 is used to carry the Broadband over the copper pair from the Street Cabinet to the End User's premises.
The Public Switched Telephony Service (PSTN) is unaffected by this technology and continues to be supplied over the copper pair between the Exchange and EU's premises.
FTTC accesses use the PPP (Point-to-Point Protocol) session establishment to inform the BRAS of the Openreach line rate. It is therefore essential that the PPP session is re-started every time the VDSL line retrains. To ensure this, the PPP / L2TP timeout values must be set to less than 20 seconds.

FTTC requires a Service Specific Front Plate to the existing metallic line box, the Network Terminating Equipment, (NTE5). The VSDL2 modem connects to the data port on the Service Specific Front Plate , the modem then presents a logical Ethernet Interface for the EU. Refer to SIN 498 [43]

The Service Specific Front Plate includes the VDSL2 filter that separates PSTN and VDSL2 signals carried over the PSTN line, it also prevents VDSL2 signalling from reaching other telephone extension sockets.

At the time of writing it is standard practice for the CPE used with these access circuits to contain VDSL modem functionality rather than using a standalone device. Openreach no longer provide standalone modems with these circuits.

Separate ADSL filters are not required in the End User's premise.

For more detail, please refer to;

SIN 360 - Ethernet Customer Interfaces - Interface Characteristics

SIN 498 – Fibre to the Cabinet (FTTC) Generic Ethernet Access Service and Interface Description

3.2.4. Fibre to the Premise (FTTP)

The FTTP product uses an overlay of fibre infrastructure to sites with existing copper infrastructure and provides an alternate access solution other than Fibre to the Cabinet (FTTC).

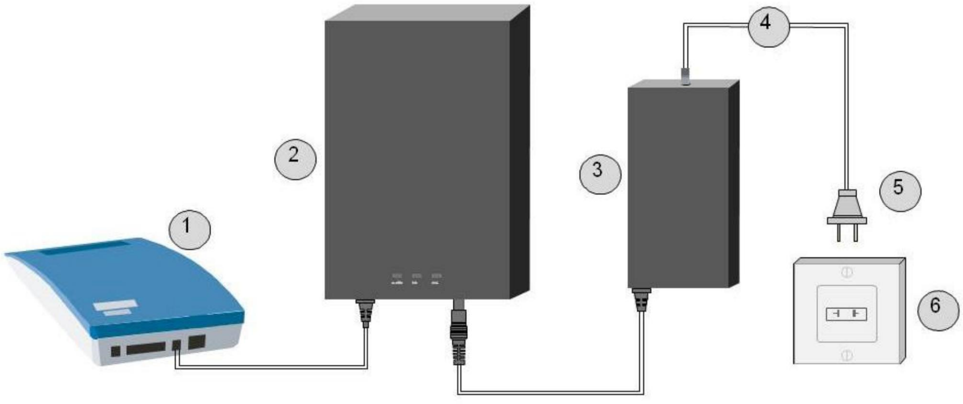
The fibre is installed between Optical Line Termination equipment within a 'Next Generation Access' Exchange building to an Optical Network Termination (ONT) device located at the EU premise. Note that there is no requirement for Dynamic Line Management with a FTTP service.

An FTTP installation comprises of two main deliverables.

I. A Fibre connection between NGA exchange and EU site, where the fibre terminates within an external Customer Splicing Point (CSP) at the EU premise.

II. An EU site installation between the external CSP and an internal Optical Network Termination device; the ONT presents an Ethernet interface for EU CPE equipment.

Note. The ONT is an active device, therefore needs to be located within reach of a power supply and should remain powered at all times; the ONT will provide four Ethernet data ports.



Legend: 1-ONT; 2–BBU; 3–Charger/Adaptor; 4/5 - AC Power Cable & Plug; 6-Power Socket

ONT – Optical Network Termination

3.3. Routing Options

Both Static Routing and Dynamic Routing (eBGP) options are supported for exchanging routing information between the PE and CE.

A number of enhanced service reliability options for IP Connect UK are offered between the customer NTE and BT's IP Connect UK.

The dynamic routing option requires the CPE to run an external BGP session across a *multihop* link in accordance to RFC 1771 A Border Gateway Protocol 4 (BGP-4) [22]. For Ethernet access all resilient sites use dynamic resilience in accordance with the above RFC. This requires the CPE to run an external BGP session between LAN interfaces, not using *multihop*.

This external BGP session supports the end to end transparency of BGP standard communities. The following communities are carried transparently by IP Connect UK.

- Any AS in the first 2 bytes of the community attribute
- Excluding core ASNs (2856, 12641)

That is, the following are allowed

- 0:0 to 2855:65535
- 2857:0 to 12640:65535
- 12642:0 to 65535:65535

Two accesses forming a resilient connection can be in different BGP AS (Autonomous System). Each BGP connected site within a VPN should use a different AS number. IP Connect UK uses both "Deterministic MED" and "Always Compare MED". BT can recommend the AS numbering plan for customer sites or the customer may select their own. Any AS number selected by the customer must either be in the Private AS number range [64521 - 65535][1] or is registered to them by a Regional Internet Registry e.g. ARIN (Canada, United States, islands in the Caribbean Sea and North Atlantic Ocean) or RIPE NCC (Europe, the Middle East, Central Asia) and must be unique for each site within a VPN.

The dynamic resilience options do not support true load sharing. As such the BGP configuration on the CPE should set MED (Multi-Exit Discriminator) values for all route prefixes which are announced to the IP Connect UK network. This enables the customer to control which connection will be used to send traffic from BT's IP Connect UK platform to them for each individual prefix that they advertise.

iBGP Multipath will be configured as default on all accesses. Customers with more than one access advertising the same routes would receive flow based load-sharing of inbound traffic across up to 4 paths (accesses). To be able to use iBGP Multipath the following must be true:

- Weights are equal
- Local-preference is equal
- AS-PATH is same. Note that entire AS-PATH should be identical
- Origin is same
- MEDs are equal

Any of the foregoing can be used to override iBGP Multipath. The use of unequal path load sharing allows accesses, which are parented on different PoPs thereby possible having different path lengths, to have approximately equal distribution of sessions.

It must be noted that "loadsharing" is session based and depends upon the source and destination IP addresses as to which path is taken; it does not take session bandwidth into consideration. "Loadsharing" will work optimally if there are large numbers of sessions; there is a risk that with traffic will be unequally routed if very small numbers of sessions are present. Access should always be of equal bandwidth.

Note that iBGP Multipath will only control inbound sessions to the multi access site. The Customer must control outbound traffic by configuration on their site

The BGP timer parameters supported by the BT network are given in Table 2. These timers may be negotiated between the network and the CPE equipment if the CPE supports this. The minimum values that should be set in the CPE are defined below. If the CPE does not support negotiation then the service defaults should be used.

Timer	BT Service Default	Minimum Value Permitted
BGP neighbour keepalive timer	60 seconds	10 seconds
BGP neighbour hold timer	180 seconds	3 × keepalive timer

Table 2. BGP timer values supported by IP Connect UK

When using BGP to advertise routing information to the network, each site will be subject to a pre-agreed maximum number of routes that it can advertise. This number of routes should not be exceeded; the network will disconnect sites that advertise more than the agreed number.

3.4. Class of Service not Enabled: #IP Precedence and DSCP Model

Where CoS features are not enabled, IP Connect UK accesses do not support by default the use of IP Precedence bits in the headers of Customers' IP packets. Any IP Precedence bit values that are set will be reset to BT's Class 3 (Default) precedence marking for transport across the network. By default the network will not re-instate the original precedence bit value. IP Precedence is no longer supplied.

3.5. Class of Service Enabled: #IP Precedence Model

Where CoS features are enabled under the IP Precedence CoS model, IP Connect UK accesses support the use of IP Precedence bits in the headers of Customers' IP packets in order to provide prioritisation of Customer data according to the values employed in the Precedence bit.

IP Connect UK supports prioritisation into 3 discrete IP Classes of Service:

- Class One
  used for low–jitter, low–delay application requirements such as Voice over IP
- Class Two
  used for data prioritised over 'general' traffic or data with underlying application performance requirements such as video
- Class Three
  used for general data

In order for IP Connect UK to handle Customer traffic according to its appropriate Class setting, the Precedence bit in the IP headers of Customer data should be set according to the following scheme:

IP Precedence		IP VPN Class of Service	In/Out of Contract Marking
Value	Binary		
6	110	2	In
5	101	3	In
4	100	1	In

Table 3. #IP Precedence Marking scheme

The precedence value of Customer traffic submitted to IP Connect UK will be set to the same value on egress from the network. Any received precedence value settings that are not in accordance with the above Precedence Marking scheme will be re–marked to Class 3 on egress.

On an Ethernet access, bits 4-6 of the ToS field (the last 3 bits of the DSCP) must be set to zero on the CPE for Class 1 and Class 2 traffic; these bits will be set to zero for all traffic on egress.

3.6. Class of Service Enabled: DSCP Model

Where CoS features are enabled under the DSCP (DiffServ Code Point) CoS model, IP Connect UK accesses support the use DSCP bits in the headers of Customers' IP packets in order to provide prioritisation of Customer data according to the values employed in the Precedence bit.

The IP Connect UK network supports prioritisation into 3 discrete IP Classes of Service:

- Class One/Expedited Forwarding
  used for low-jitter, low-delay application requirements such as Voice over IP
- Class Two/Assured Forwarding
  used for data prioritised over 'general' traffic or data with underlying application performance requirements such as video. Up to four discrete AF classes are available to segregate Customers' prioritised or performance-sensitive data traffic
- Class Three/Default (or "Best Efforts")
  used for general un-prioritised data

When supporting EF on a DSL access the CPE must be configured for MLPPP and fragmentation will be applied to IP packet.

In order for IP Connect UK to handle Customer traffic according to its appropriate Class setting, the DSCP bit in the IP headers of Customer data will be processed according to the following precedence marking scheme:

Marking on BT Network			Classification	
Binary	Octal	Ingress/Egress treatment (In/Out of Contract)	DiffServ Code Point	Class
101000	5-0	In	EF	Class 1
101110	5-6	In	EF	Class 1
100000*	4-0*	In		Class 2/AF4
100010	4-2	In	AF41	Class 2/AF4
100100	4-4	Out	AF42	Class 2/AF4
100110	4-6	Out	AF43	Class 2/AF4
011000*	3-0*	In		Class 2/AF3
011010	3-2	In	AF31	Class 2/AF3
011100	3-4	Out	AF32	Class 2/AF3
011110	3-6	Out	AF33	Class 2/AF3

010000*	2-0*	In		Class 2/AF2
010010	2-2	In	AF21	Class 2/AF2
010100	2-4	Out	AF22	Class 2/AF2
010110	2-6	Out	AF23	Class 2/AF2
001000*	1-0*	In		Class 2/AF1
001010	1-2	In	AF11	Class 2/AF1
001100	1-4	Out	AF12	Class 2/AF1
001110	1-6	Out	AF13	Class 2/AF1
000000	0	In	DE	Class 3

*= DSCP Class Selector/Truncated DSCP value

Table 4. DSCP Precedence Marking Scheme (based on RFC2597 [37])

The precedence value of Customer traffic submitted to IP Connect UK will be set to the same value on egress from the network. By default, any received precedence value settings that are outside of the DSCP framework will be re–marked to Class 3/Default on egress.

4. Interface Descriptions

IP Connect UK access connections support the following types of customer interface:

1. 100 Mbit/s
   RJ-45 connection with IEEE 802.3 [24] Ethernet at 10 or 100Mb/s, in half or full duplex mode.
2. 1000 Mbit/s
   1000Base SX optical presentation with IEEE 802.3 [24] Gigabit Ethernet framing.
3. 10Gbit/s 10000base LR interface with SC connectors
4. DSL
   Analogue BT-provided PSTN direct exchange line.
5. SOGEA See STIN517 [46]

4.1. /100 Mbit/s

The interface is the Network Termination Point (NTP), i.e. the point of connection between the BT Network Terminating Equipment (NTE) and the CPE interface. The Customer Interface consists of an RJ-45 type socket. The customer provides the category 5 connecting cords between the NTE and their own CPE. The maximum cable length is 100m.

The RJ-45 type connector is as specified in the 10BaseT and 100BaseT IEEE 802.3u/x [30] [31] specifications. Attention is drawn to the Intellectual Property Rights (IPRs) set out in the preface of this agreed International standard. It is the responsibility of the CPE supplier to ensure that they have the necessary rights from the owner of the IPR. The IPR owner has stated that they are willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world.

Ethernet Access will be provided using BT Downstream 21CN Ethernet Services (SIN 476) , , The customer's equipment will need to be set to Auto-negotiate "on" in order to work correctly, the NTE will then negotiate interface speed.

4.2. 1000 Mbit/s

1000Mbit/s (Gigabit Ethernet) conforms to the IEEE 802.3 [24] standard.

The interface is the Network Termination Point (NTP), i.e. the point of connection between the BT Network Terminating Equipment (NTE) and the CPE interface. The Customer Interface consists of a Dual SC type 1000Base SX fibre interface. The customer provides the fibre patch connectors between the NTE and CPE, the maximum fibre length is 550m.

The SX type connector is as specified in the Gigabit Ethernet IEEE802.3z [32] specification. Attention is drawn to the Intellectual Property Rights (IPRs) set out in the preface of this agreed International standard. It is the responsibility of the CPE supplier to ensure that they have the necessary rights from the owner of the IPR. The IPR owner has stated that they are willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world.

Protocol	Gigabit Ethernet IEEE 802.3z [32]
Line Rate	1.25 Gbit/s
Maximum Bit Error Rate	10^{-12}
Power Requirement	Mains voltage 50 Hz AC input, 50 watt
Customer Fibre Connector	SC type
SX Fibre ***(Customer provided)***	Multi-mode 850nm, 50/125 or 62.5/125 micron
SX Fibre Maximum Delivery Distance	550 m from NTE's SX port
Operating Temperature	0° to 40° C
Laser Safety	Class 1 under all conditions as per IEC 825-1 [33]
AUTONEGOTIATION	ON

Table 5. 1000Mbit/s Ethernet NTE technical specification

4.3. 10Gbp/s

10Gbit/s (Gigabit Ethernet) conforms to the IEEE 802.3 [24] standard.

The interface is the Network Termination Point (NTP), i.e. the point of connection between the BT Network Terminating Equipment (NTE) and the CPE interface. The Customer Interface consists of a Dual SC type 1000Base SX fibre interface. The customer provides the fibre patch connectors between the NTE and CPE, the maximum fibre length is 550m.

The SX type connector is as specified in the Gigabit Ethernet IEEE802.3z [32] specification. Attention is drawn to the Intellectual Property Rights (IPRs) set out in the preface of this agreed International standard. It is the responsibility of the CPE supplier to ensure that they have the necessary rights from the owner of the IPR. The IPR owner has stated that they are willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world.

4.4. #ADSL1/ADSL2/2 +

Customer ADSL CPE requires an ADSL port to provide a connection, noting that the ADSL connection supports a single VC.

The ADSL interface will utilise an ADSL/ CPE filter which is not supplied as part of the service.

4.5. Fibre to the Cabinet (FTTC)

Fibre to the Cabinet utilises VDSL2 signalling delivered via MPF pairs to the EU premise. The metallic path terminates on the NTE5 at EU premise.

The NTE Special Service faceplate includes an integral VDSL2 filter that separates analogue voice from VDSL2 signalling; a VDSL2 modem then connects to the VDSL2 filter outlet port.

The VDSL2 modem in turn presents a logical Ethernet interface for EU CPE connection.

The VDSL2 modem should remain powered at all times.

For further detail: SIN 498[43]

4.6. Fibre to the Premise (FTTP)

Fibre to the Premise utilises Openreach Generic Ethernet Access between End User Access up to a enabled exchange, The FTTP service delivers a single Virtual Local Area Network (VLAN) to the EU premise.

An Optical Network Termination device (ONT) installed at the EU premise terminates the optical path and presents 4 logical Ethernet interfaces as EU connection.

For general information regarding this service, please refer to SIN509[45] and SIN506[44].

5. Physical arrangements

5.1. Physical Location of Connectors

The User–Network Interface (UNI) is located at the connector on the BT Network Terminating Equipment (NTE) with a connector on the Customer side as described in the relevant part of Section 4 of this document.

5.2. NTE Power Supply Requirements

The NTE is locally powered and will require either a single or dual local mains 50Hz AC supplies (dependant on access rate).

The NTE will be installed in accordance with standard BT practises in agreement with the Customer.

5.2.1. 100/1000 Mbit/s and 10Gbp/s

The NTE is powered from the normal domestic mains supply, standard CEE 22 (IEC 320 [36]) inlets which are fitted to the rear panel of the NTE. The appropriate mains cord is supplied.

The power consumption of the BT NTE is typically 50 watts.

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5.2.2. #ADSL1 and ADSL2/2+

The service boundary only extends to the Master Telephone Socket and does not include internal wiring. Thus no additional power is required for an NTE.

[Note]: It is advised that Broadband routers do not share power outlets with other electrical devices that demand high power and switching current as this may cause electrical interference via the power supply. If the sharing of power outlets is unavoidable, the EU may need to deploy a mains conditioner or UPS system to help remove any causes of electrical interference.

5.2.3. Fibre to the Cabinet (FTTC)/SOGEA

#The Openreach supplied VDSL2 modem is an active device and must remain powered and connected at all times.

The power supply unit (PSU) to the Openreach VDSL2 modem will be a single, low voltage power interface. [Note]

For NTE dimension detail: SIN 498[43]

5.2.4. Fibre to the Premise (FTTP)

The Optical Termination Device serves as the service point of End User connection.

The ONT will be fixed to a wall within 1m of a fixed power socket.

The power supply to the ONT will be a single, low voltage power interface including the capability for battery backup when available. The PSU will be suitable for use with standard domestic UK supplied 230V (AC). The power consumption is <12 W. [Note]

- ONT Power supply 11 – 14 V DC, 1 A
- Power adapter input 100 – 240 V AC, 50 – 60 Hz

Power consumption Minimum: 6 W, Maximum: 12 W, Average: 7.5 W

For further detail: SIN 506[44].

6. References

[1]	Frame Relay Forum implementation agreement 1.2, “User–to–Network (UNI) Implementation Agreement”, April 2000
[2]	ITU–T Recommendation I.233, “Frame Mode Bearer Services”, March 1993
[3]	IETF RFC 2427, “Multiprotocol Interconnect over Frame Relay”, September 1998 (replaced RFC 1490)
[4]	ITU–T Q.933 Annex A, “Digital subscriber signalling system No. 1 (DSS 1) – Signalling specifications for frame mode switched and permanent virtual connection control and status monitoring”, October 1995
[5]	ANSI T1.617 Annex D, “Digital Subscriber System No. 1 DSS1 Signalling Specification for Frame Relay Bearer Service”, Revised 1997
[6]	ITU–T Recommendation X.21, “Interface between Data Terminal Equipment and Data Circuit–terminating Equipment for synchronous operation on public data networks”, September 1992
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[34]	SIN 346, BT ADSL Interface Description
[35]	ITU–T Recommendation G.992.1, Asymmetrical Digital Subscriber Line (ADSL) transceivers
[36]	IEC 320, International Standardized Appliance Connectors
[37]	IETF RFC 2597 “Assured Forwarding PHB Group”, June 1999.
[38]	IETF RFC 2364 "PPP Over AAL5"
[39]	SIN 472 - BT Wholesale Broadband Connect (WBC) Products, Service Description
[40]	SIN 476 - BT Downstream 21CN Ethernet Services, Service Description
[41]	SIN 492 - Ethernet Access Direct (EAD) and Ethernet Access Direct Local Access, Service & Interface Description
[42]	SIN 495 – BT Wholesale Broadband Connect Fibre to the Cabinet Service, Service Description
[43]	SIN 498 – Fibre to the Cabinet (FTTC) Generic Ethernet Access Service and Interface Description
[44]	SIN 506 – Fibre to the Premise (FTTP) Generic Ethernet Access .
[45]	SIN 509 – BT Wholesale Broadband Connect (WBC) Fibre to the Premise (FTTP)
[46]	STIN 517 -Single Order Generic Ethernet Access (SOGEA), Service & Interface Description

7. Abbreviations

AAL5	ATM Adaptation Layer 5
ADSL	Asymmetric Digital Subscriber Line
AF	Assured Forwarding
ANSI	American National Standards Institute
AS	Autonomous System
ATM	Asynchronous Transfer Mode
BGP	Border Gateway Protocol
BTNR	British Telecommunications Network Requirements
CE	Customer Edge
CoS	Class of Service

CPE	Customer Premises Equipment
DF	Do not Fragment bit
DLCI	Data Link Connection Identifier
DSCP	DiffServ Code Point
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
EUDP	End User Data Path
FRF	Frame Relay Forum
HDB3	High Density Bi–polar 3
IETF	Internet Engineering Task Force
iBGP	internal Border Gateway Protocol
IP	Internet Protocol
IPR	Intellectual Property Rights
ITU–T	International Telecommunication Union
LMI	Local Management Interface
MAC	Medium Access Control
MED	Multi-Exit Discriminator
MPLS	Multi–Protocol Label Switching
MPF	Metallic Path Facility
MTU	Maximum Transmission Unit
NRZ	Non-Return to Zero
NTE	Network Terminating Equipment
PC	Physical Contact
PE	Provider Edge
PHB	Pre-Hop-Behaviour
POS	Packet Over SONET/SDH
PPP	Point-to-Point Protocol
PSTN	Public Switched Telephone Network
PVC	Permanent Virtual Circuit
RFC	Request For Comment
SDH	Synchronous Digital Hierarchy
SIN	Suppliers' Information Note
SONET	Synchronous Optical NETwork
TDM	Time Division Multiplexing
ToS	Type of Service
UNI	User/Network Interface
VC	Virtual Channel
VCI	Virtual Connection Identifier
VLAN	Virtual Local Area Network
VP	Virtual Path
VPI	Virtual Path Identifier
VPN	Virtual Private Network

8. History

Issue	Date	Revision changes
Issue 1.0	19 September, 2001	First Issue
Issue 1.1	08 October 2001	Correction to quoted standard in section 4 item 3
Issue 1.2	08 November 2001	Addition of 512 kbit/s rate on X.21 interface.
Issue 1.3	06 February 2002	Addition of 64 & 128 kbit/s rates on X.21 interface.
Issue 1.	27 February 2002	Addition of 3.3 to clarify use of dynamic resilience option.
Issue 2.0	12 July 2002	Addition of the Flex service section 3.6 refers Clarification of the use of IP Precedence bits section 3.4 & 3.5 refer
Issue 2.1	07 May 2003	Addition of Ethernet and DSL access options. Modified FRF.12 fragment sizes for IP Connect UK Flex. Approval Requirements statement removed, information available via SINet Useful Contacts page.
Issue 2.2	05 August 2003	Text and title format changes Section 3.4 to 3.8. Detail added to reflect support of DSCP Class of Service model (Section 3.6).
Issue 2.3	26 October 2004	CoS Enabled, DSCP Model description clarified.
Issue 2.4	02 December 2004	Addition of BGP Standard Community Attributes transparency, iBGP Multipath, “Always Compare MED”
Issue 2.5	06 May 2005	Correction of DSL shaping parameters in Table 1. Change to PPPoA encapsulation with optional Radius Server authentication for DSL service. Clarification of advice for customer's DSL splitter/filter.
Issue 2.6	17 January 2007	Amendments to GiGE interface – Autonegotiation needs to be set to ‘ON’. BGP enhancements on DSL. Typos corrected and redundant information removed.
Issue 2.7	10 July 2009	Addition of Ethernet in First Mile (EFM) Access Option utilising Local Loop Unbundling. Includes Section 3.2.2.2, 10Mbit/s EFM at Section 4.5.2 and additional power information at Section 5.2.3.
Issue 2.8	July 2013	Service Name Change from IP Clear to IP Connect UK. Additional SIN references describing 21CN Ethernet Services. The addition of Wholesale Broadband Connect access options: ADSL2+; Fibre to the Cabinet (FTTC); Fibre to the Premise (FTTP).
Issue 2.9	September 2014	Change SINet site references from http://www.sinet.bt.com to http://www.btplc.com/sinet/
Issue 3.0	October 2015	Multiple changes
Issue 3.1	April 2020	Changes to Table 1. IP Connect UK access rates. Update to para 3.2.1 - Leased Line access (legacy - not available for new orders) New para 4.7, 10Gbp/s
Issue 3.2	August 2020	Change SINet site references from http://www.btplc.com/sinet/ to https://www.bt.com/about/sinet
Issue 3.3	June 2021	Added references to 10Gbit/s services. Modified FTTP to show it as current rather than future service. Modified EFM to show it as a deprecated access option.

		Added note that leased line access is subject to end of service notification.
Issue 3.4	March 2024	Removed references to leased line, 10M Ethernet that are no longer offered and renumbered. Sections 1, 3.1, 3.2, 3.7, 3.8, 4, 4.1, 4.2, 4.3, 4.4, 4.8 and 5.2 Tables 1, 2, 6 and 7

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